Experiment 1 Preliminary Work
Diodes and Rectifiers

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1 Introduction

2 Step 1

Notes on signal generators, oscilloscopes and multimetersi are studied and reviewed the fundamentals.

3 Step 2

Notes on dioedes document is studied. The datasheets of the diodes to be used in this experiment are reviewed, which are 1N40007 , BA159 ,AA119 ,and BZX55C-6V2.

4 Step 3

In this step characteristics of linear modeled junction diodes are analyzed according to the I vs V equation as follows,

$$I = I_s[e^{\frac{qV}{nkT}} - 1]$$

Ideality constant n is taken 1 for both cases. From explanation in the manual $\frac{kT}{q}$ is taken as 25 mV at temperature (20∘C) . The common pievewise linear model for a junction diode is given in Figure 1.

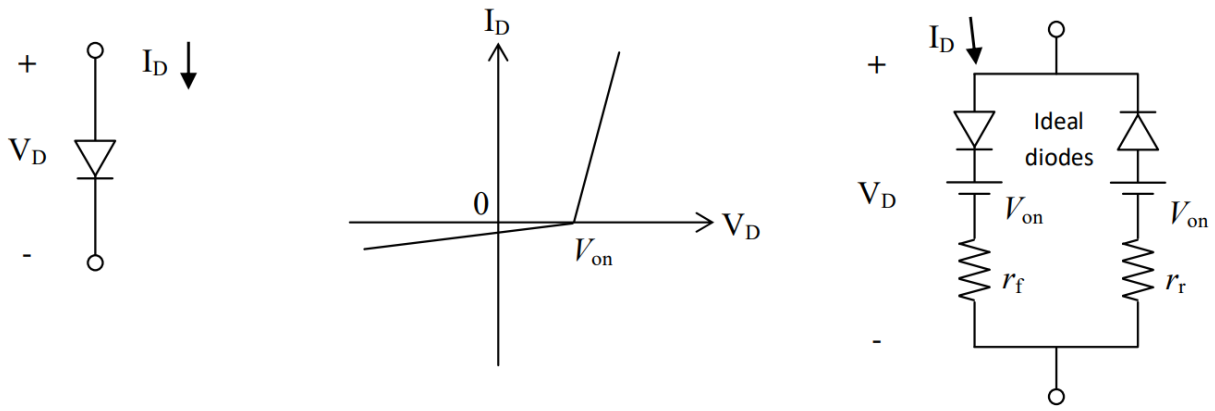

Figure 1: Common piecewise linear model for a junction diode.

4.1 a)

Table 1: I vs V

V(Volts)	I (Amps)
-0.40	-2.499999718662063e-07
-0.20	-2.499161343430244e-07
0	0
0.10	1.339953750828606e-05
0.20	7.449894967604320e-04
0.30	0.040688447854751
0.40	2.221527380126968

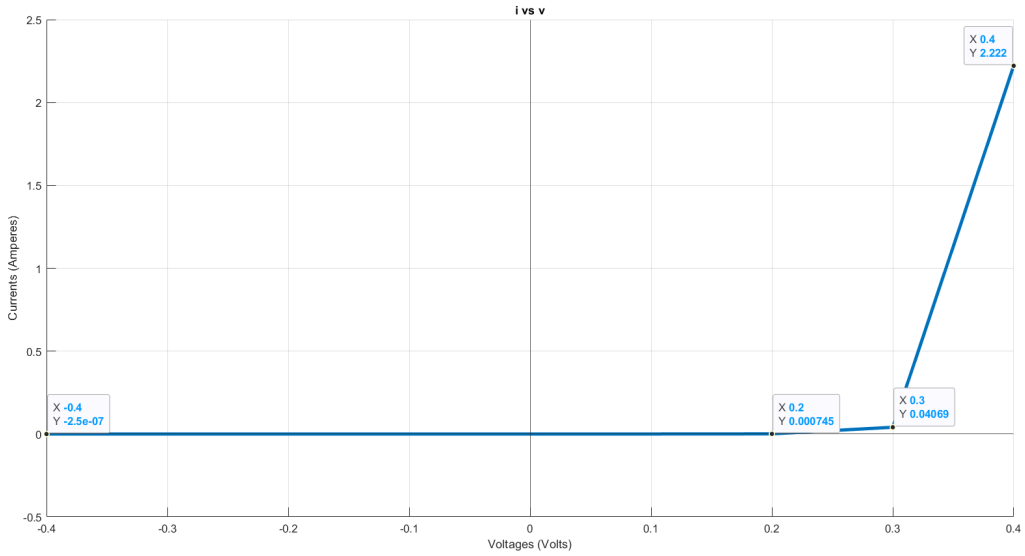

Figure 2: i versus v plot

Table 2: Parameters obtained from the plot

V_{on}	r_f	r_r
0.3V	0.046Ω	2.5Ω

4.2 b)

Table 3: I vs V

V(Volts)	I (Amps)
-0.40	-9.999998874648254e-16
-0.20	-9.996645373720976e-16
0	0
0.20	2.979957987041728e-12
0.40	8.886109520507873e-09
0.50	4.851651944097903e-07
0.60	2.648912212884338e-05
0.70	0.001446257064290
0.80	0.078962960182680

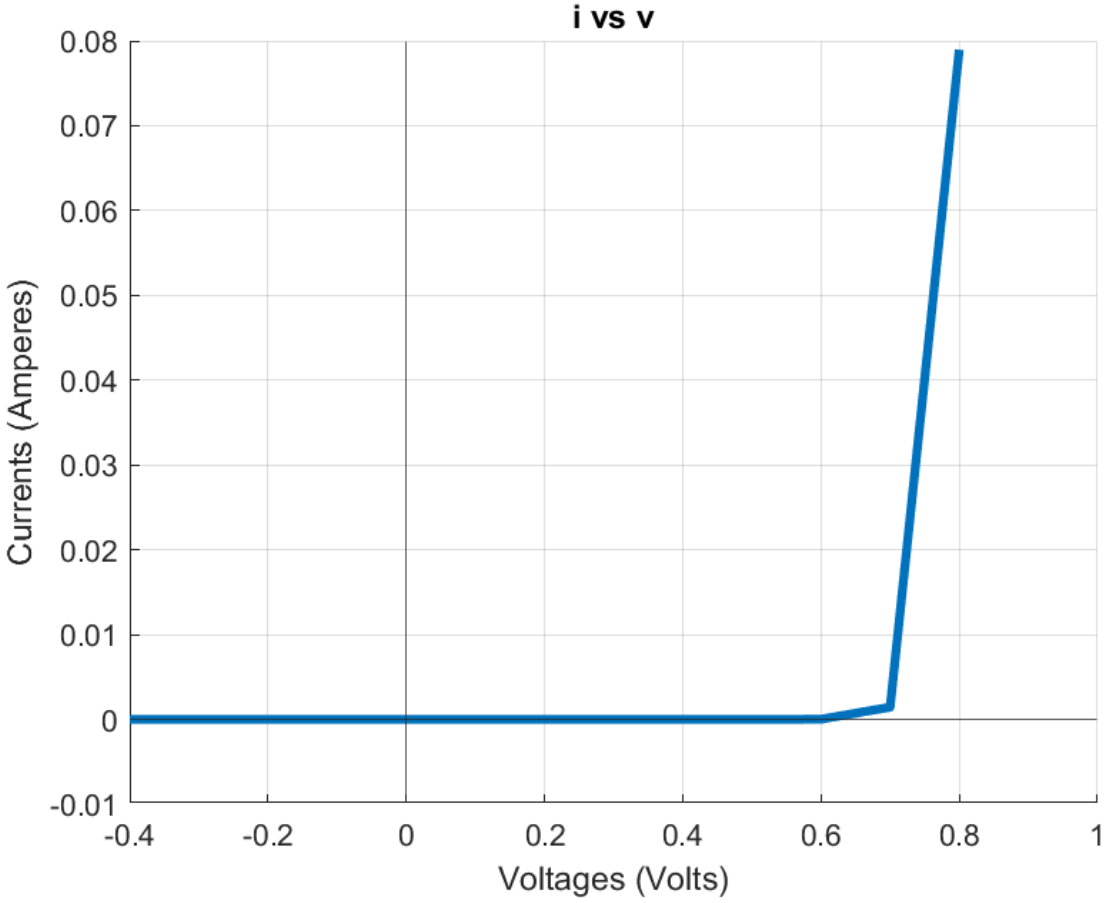

Figure 3: i versus v plot

Table 4: Parameters obtained from the plot

V_{on}	r_f	r_r
0.7V	1.2893Ω	68.97Ω

5 Step 4

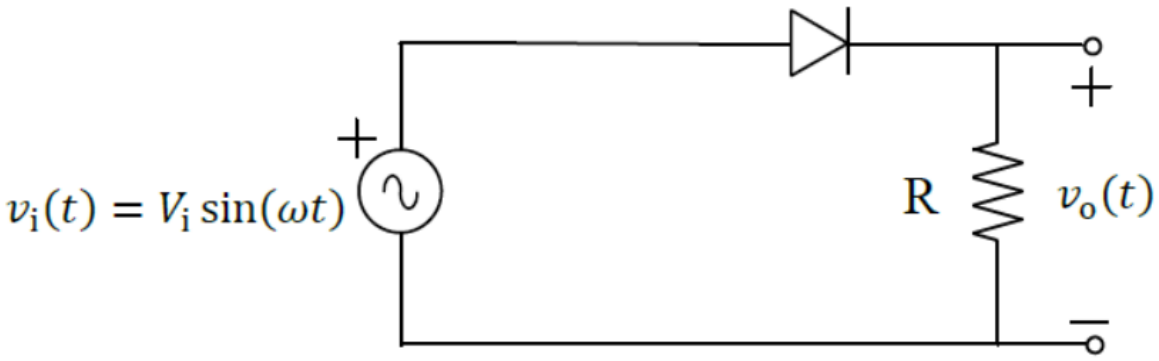

Figure 4: Half-wave circuit schematic for the Step 4

6 Step 5

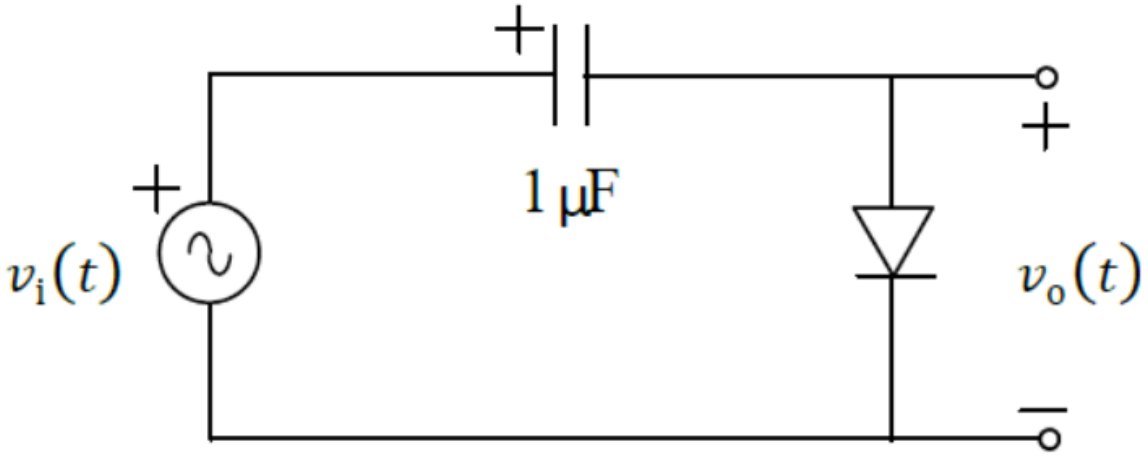

Figure 5: Diode clamper circuit schematic for the Step 5

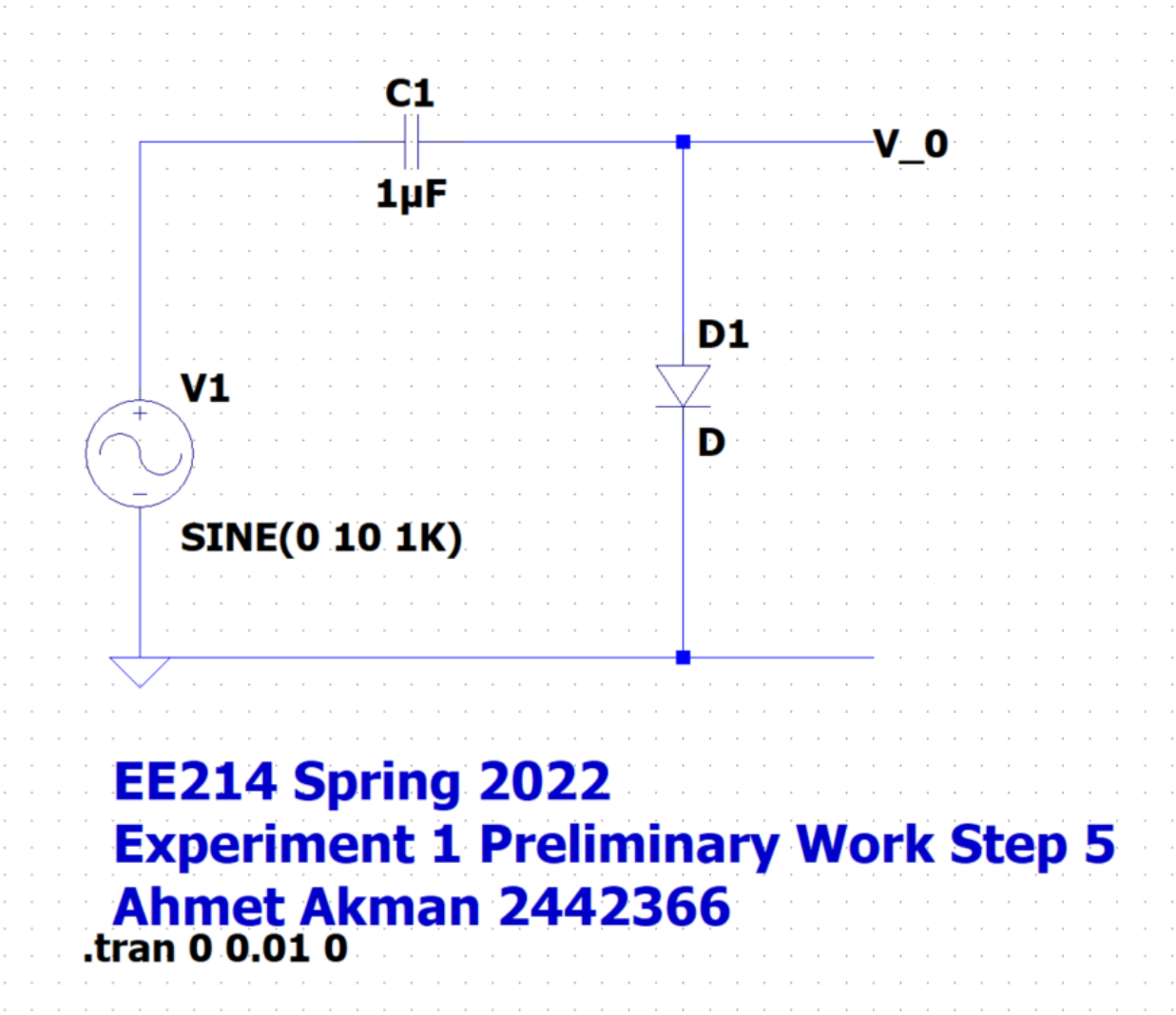

Figure 6: Diode clamper circuit simulation schematic for the Step 5

6.1 a)

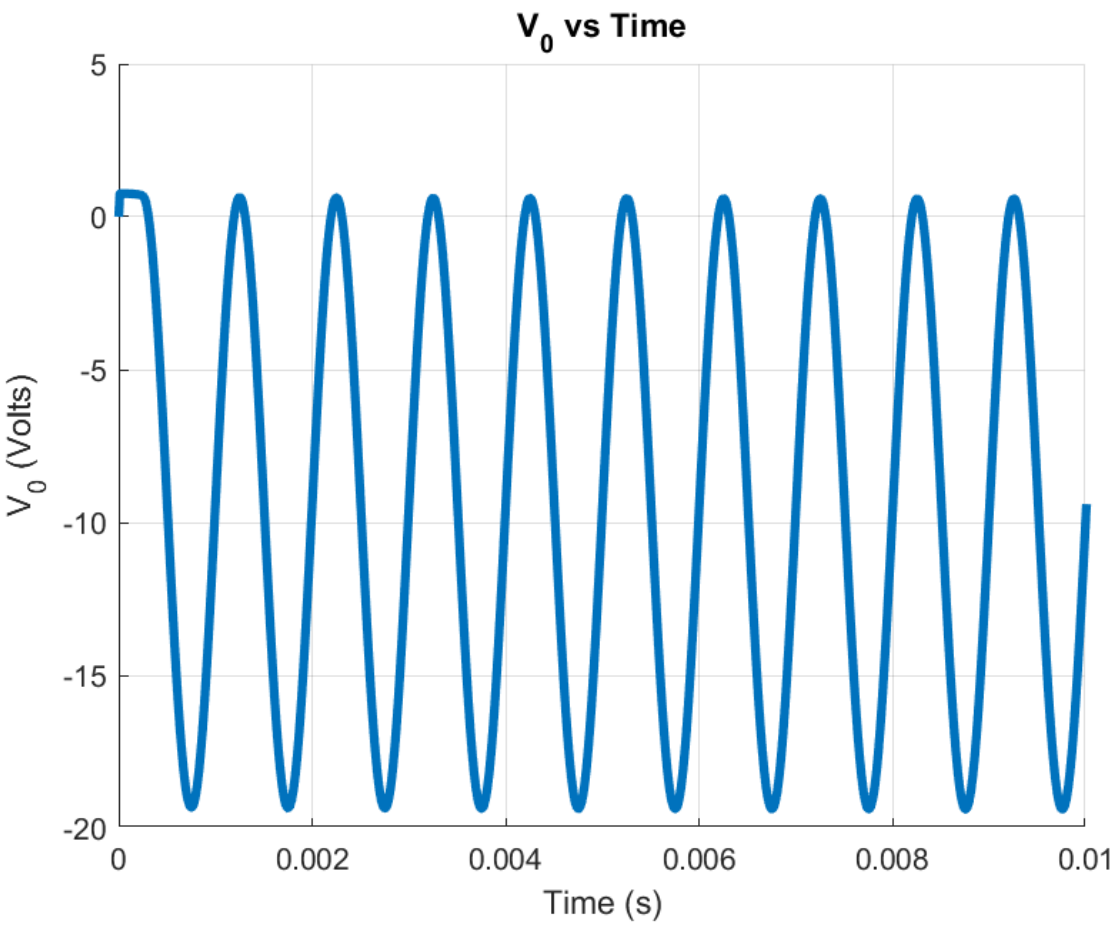

Figure 7: Diode clamper circuit simulation plot

6.2 b)

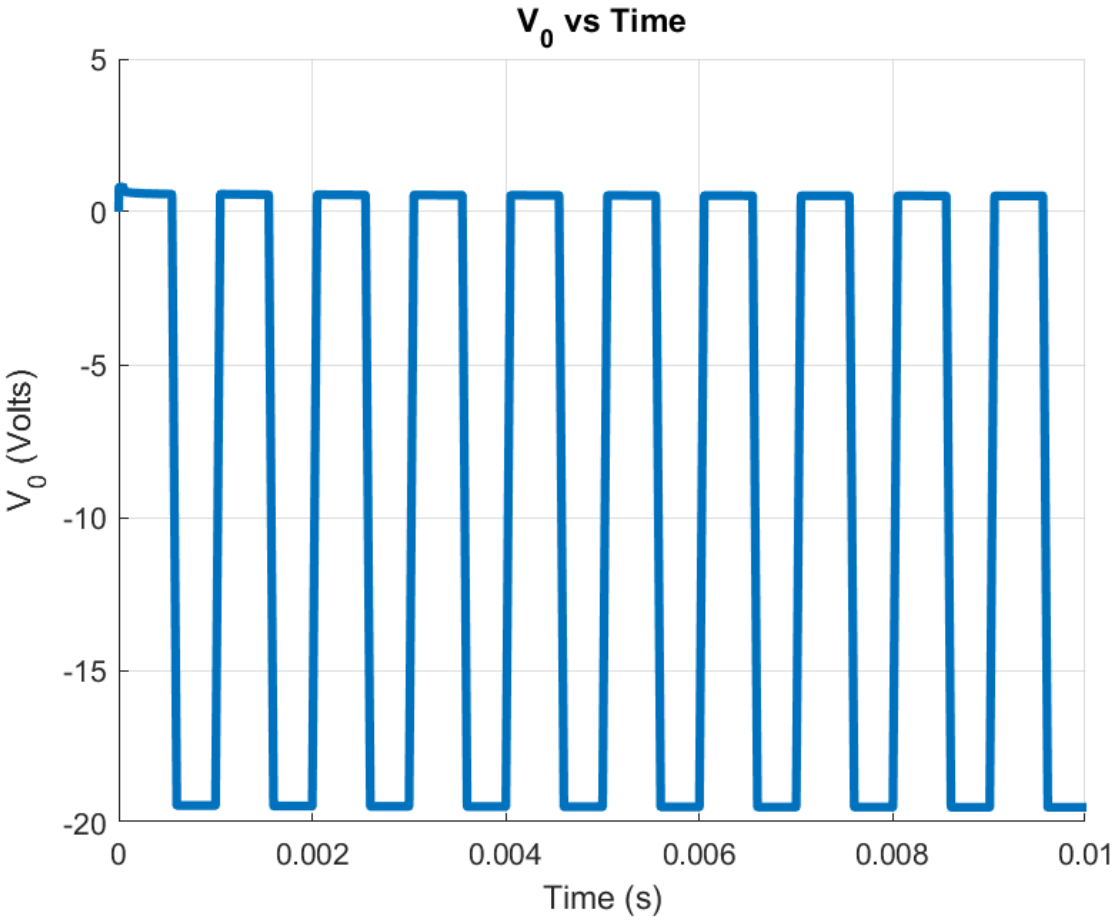

Figure 8: Diode clamper circuit simulation plot (Square wave input)

7 Step 6

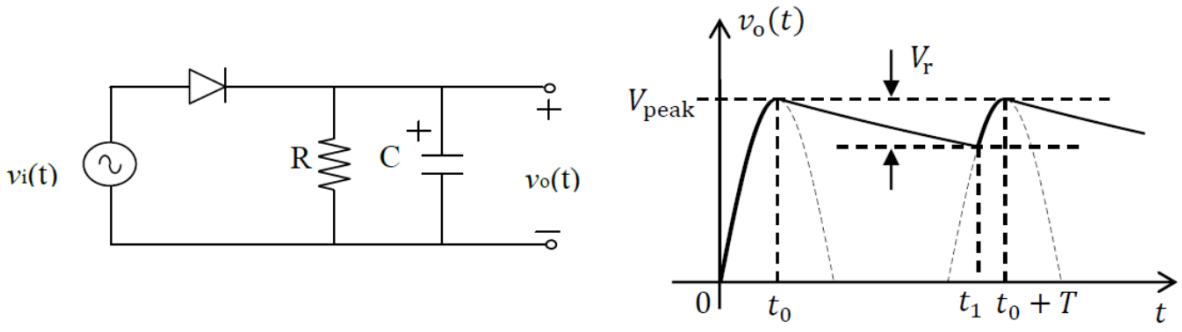

Figure 9: Half-wave rectifier circuit schematic for the Step 6

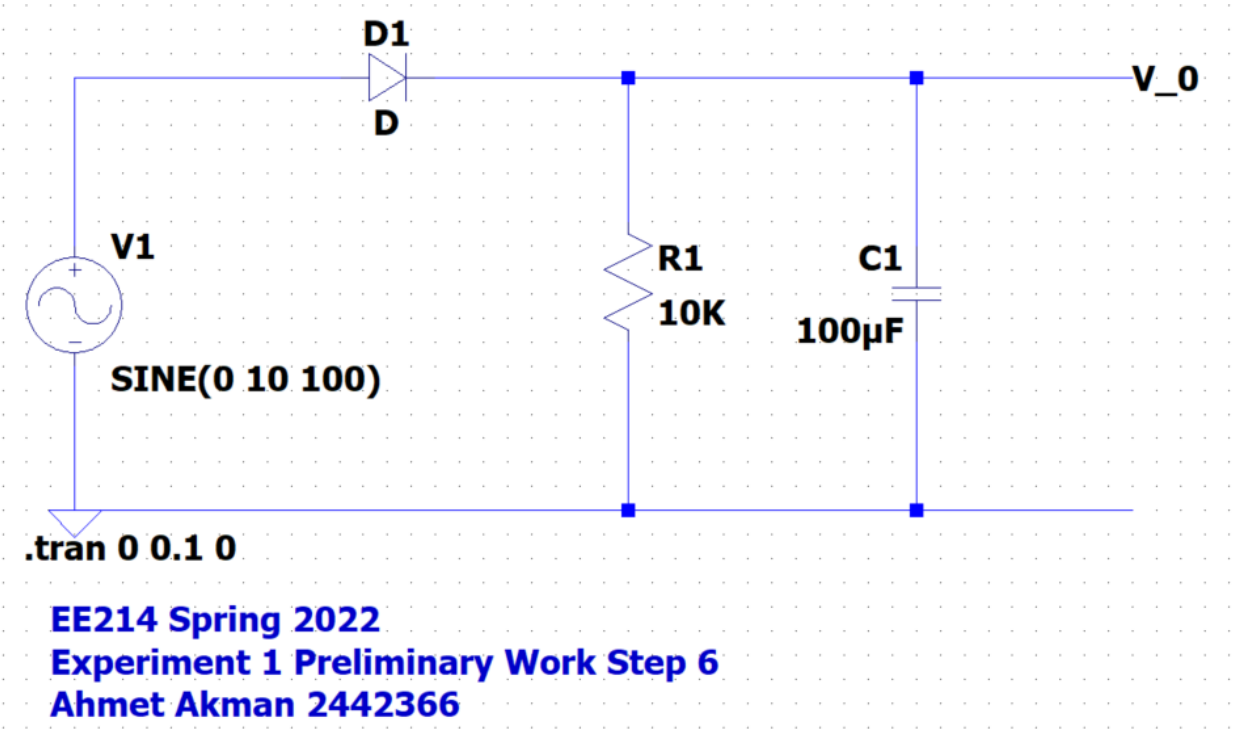

Figure 10: Half-wave rectifier circuit simulation schematic for the Step 6

7.1 a)

7.2 b)

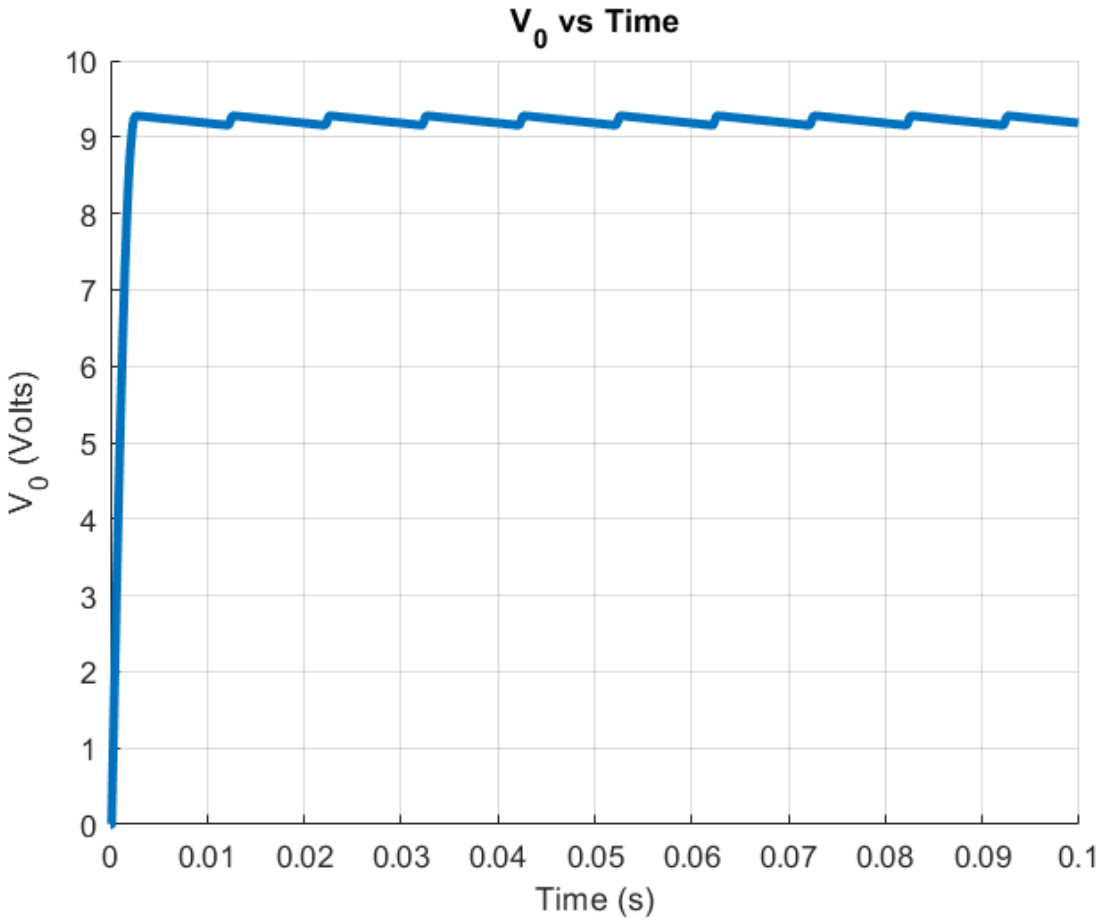

Figure 11: Half wave rectifier circuit simulation plot V_o

7.3 c)

8 Step 7

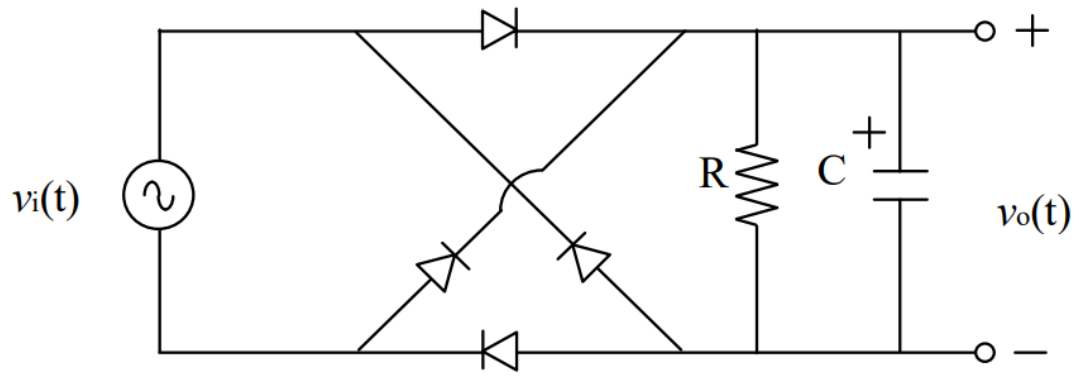

Figure 12: Full-wave rectifier circuit schematic for the Step 7

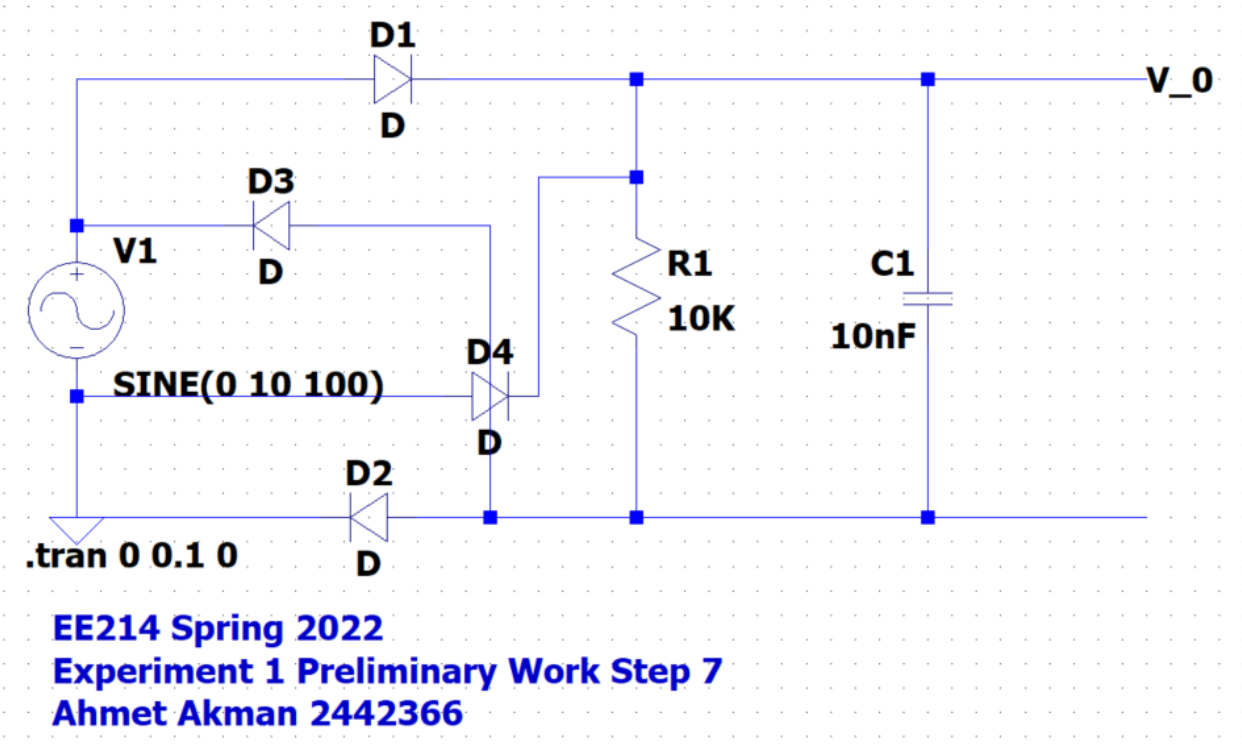

Figure 13: Full-wave rectifier circuit simulation schematic for the Step 7

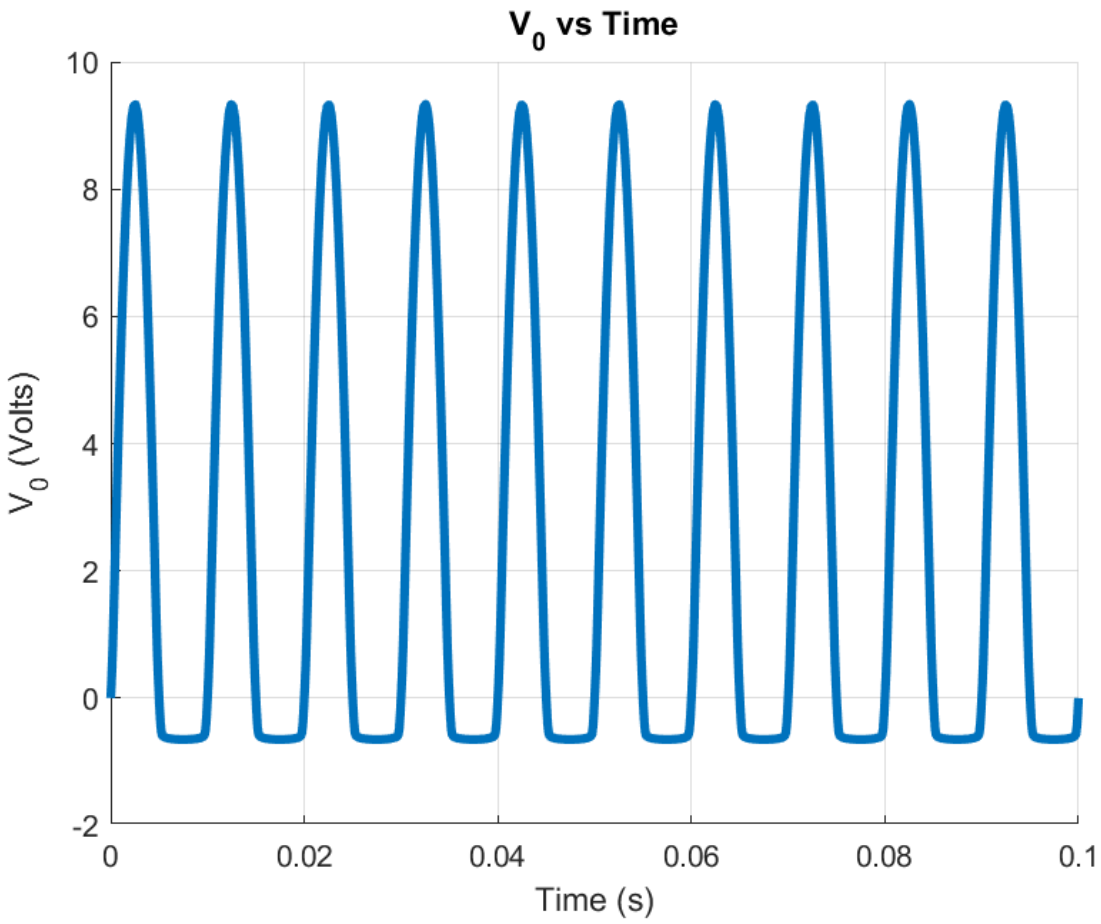

Figure 14: Full-wave rectifier circuit simulation plot V_o —— no capacitor

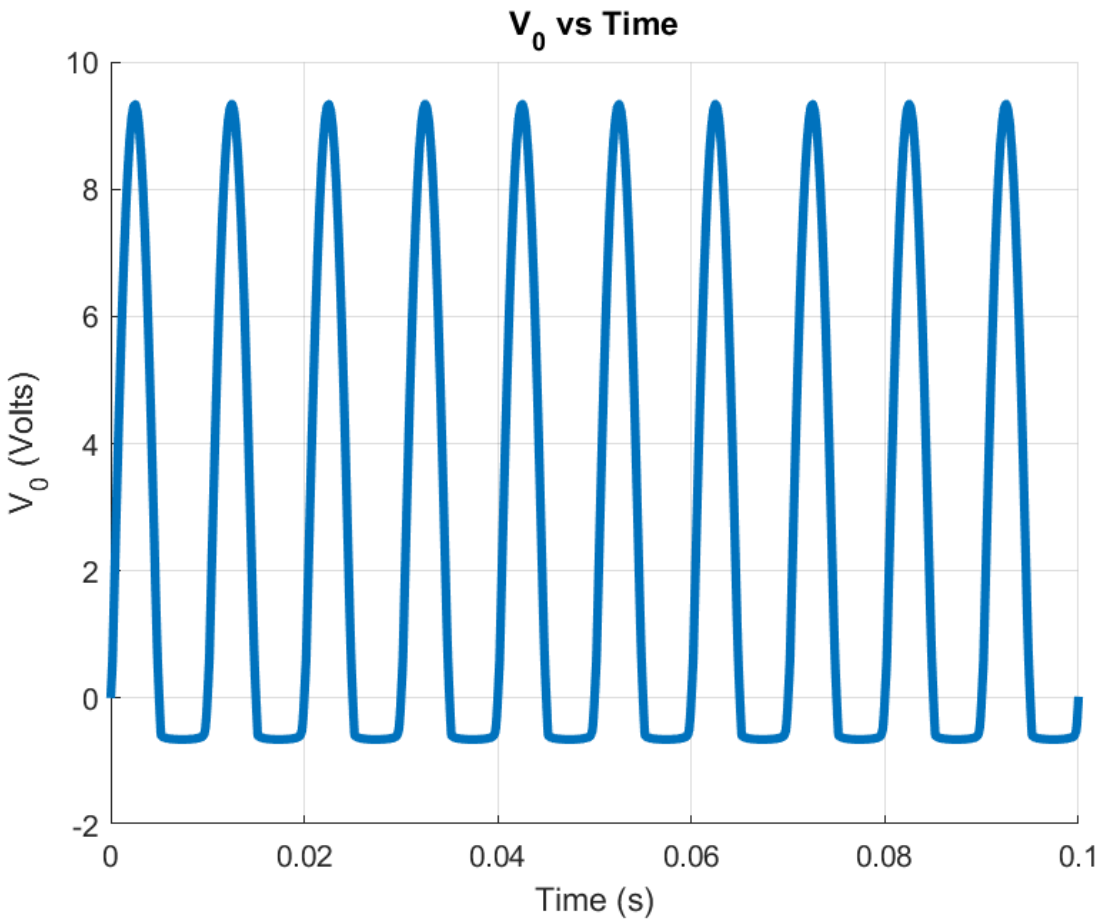

Figure 15: Full-wave rectifier circuit simulation plot V_o —— 10nF capacitor

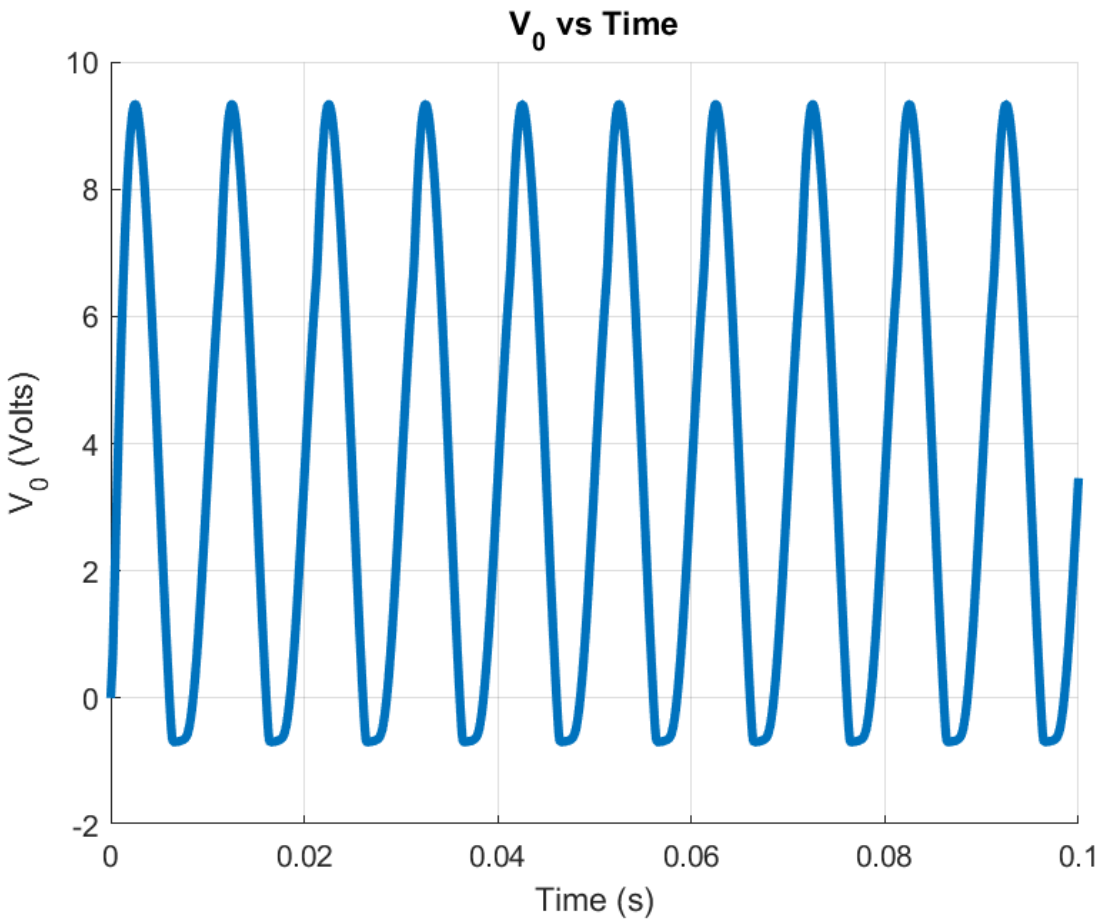

Figure 16: Full-wave rectifier circuit simulation plot V_o —— 1uF capacitor

9 Step 8

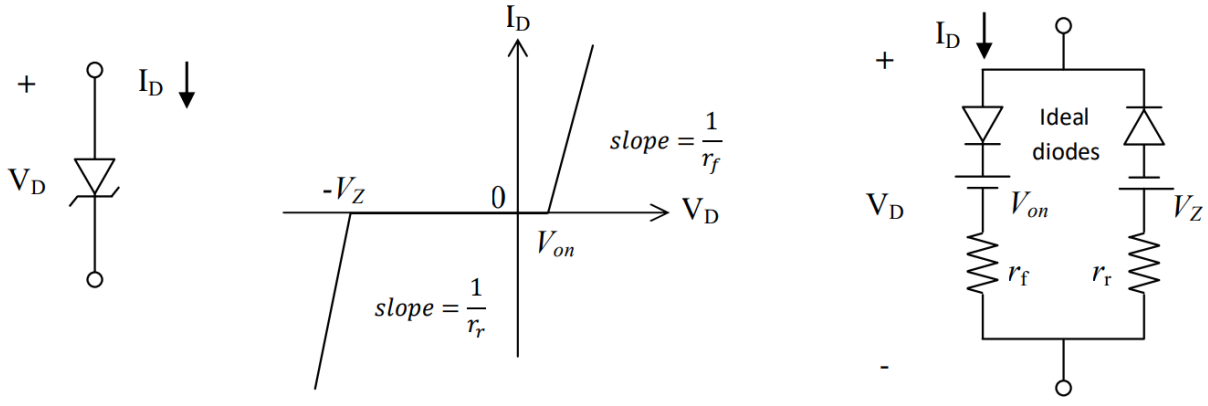

Figure 17: Common piecewise linear model for a zener diode.

Table 5: Parameters from datasheet

Parameter	Value
V_{on}	0.5V
V_z	6.2V
r_f	0.003 Ω
r_r	1 to 10 Ω

10 Step 9

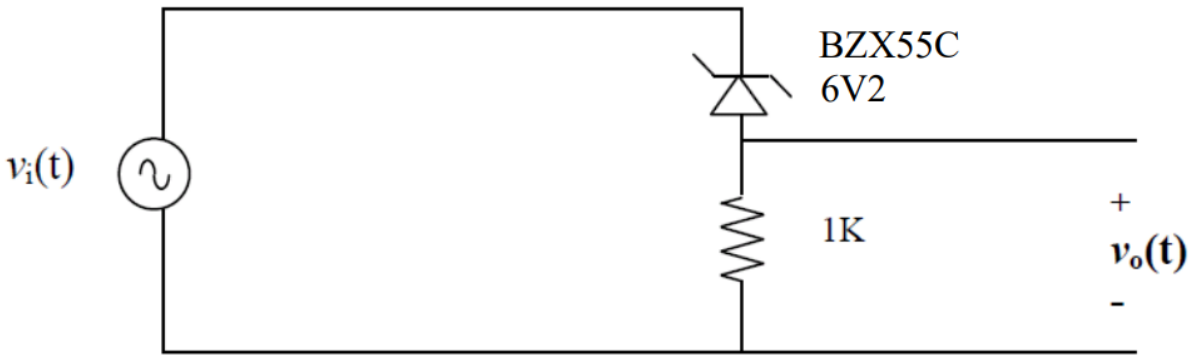

Figure 18: DC level shifter circuit schematic for the Step 9

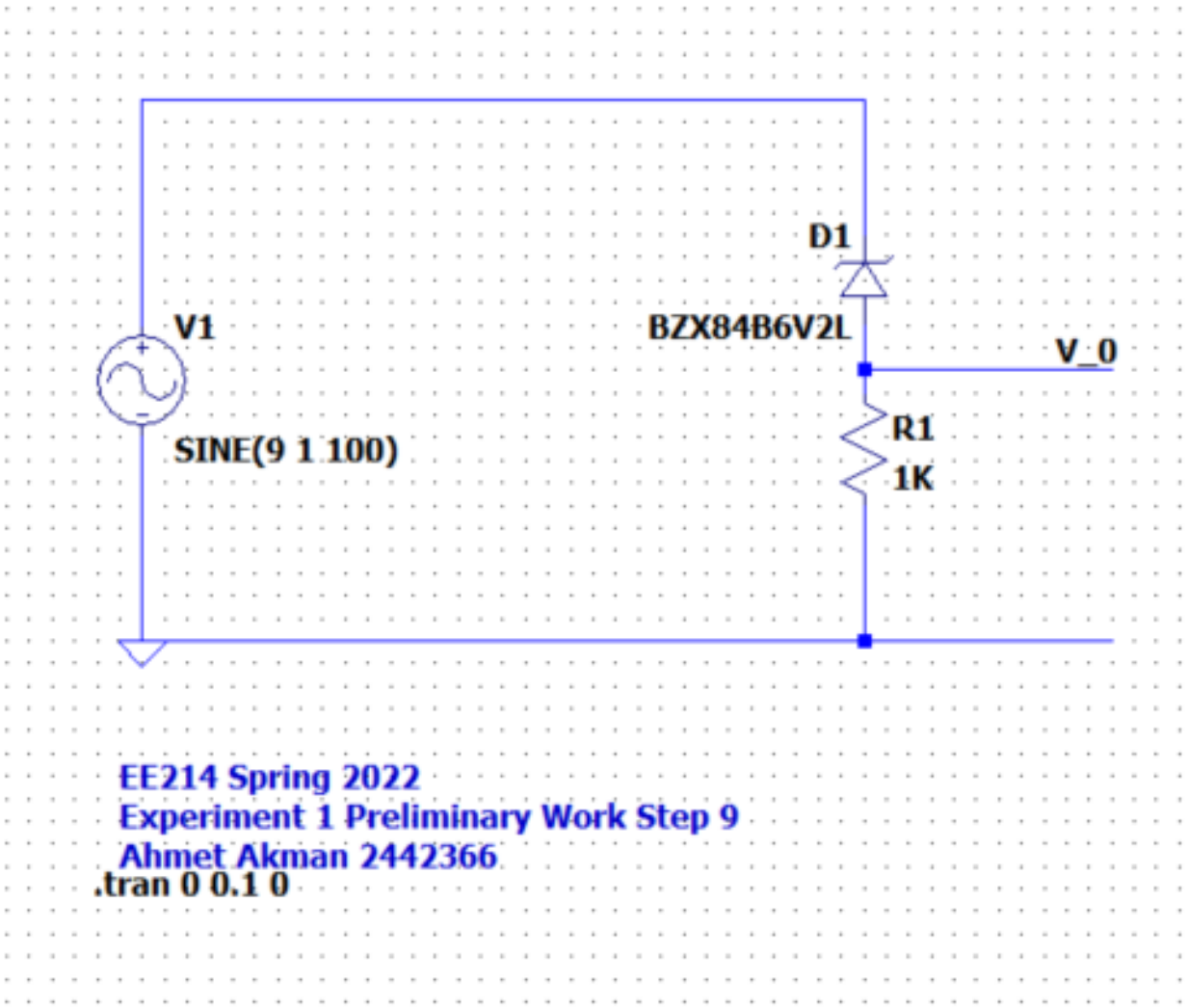

Figure 19: DC level shifter circuit simulation schematic for the Step 9

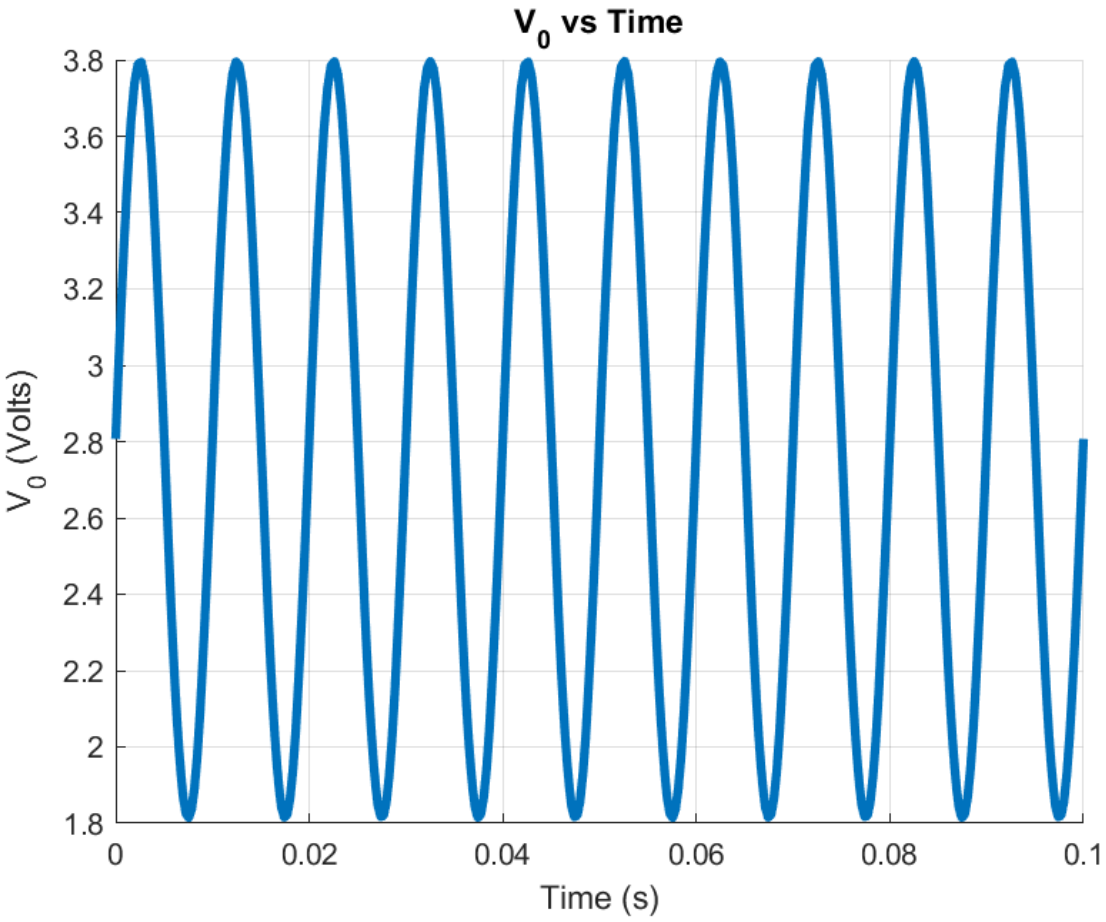

Figure 20: DC level shifter circuit simulation plot V_o

11 Step 10

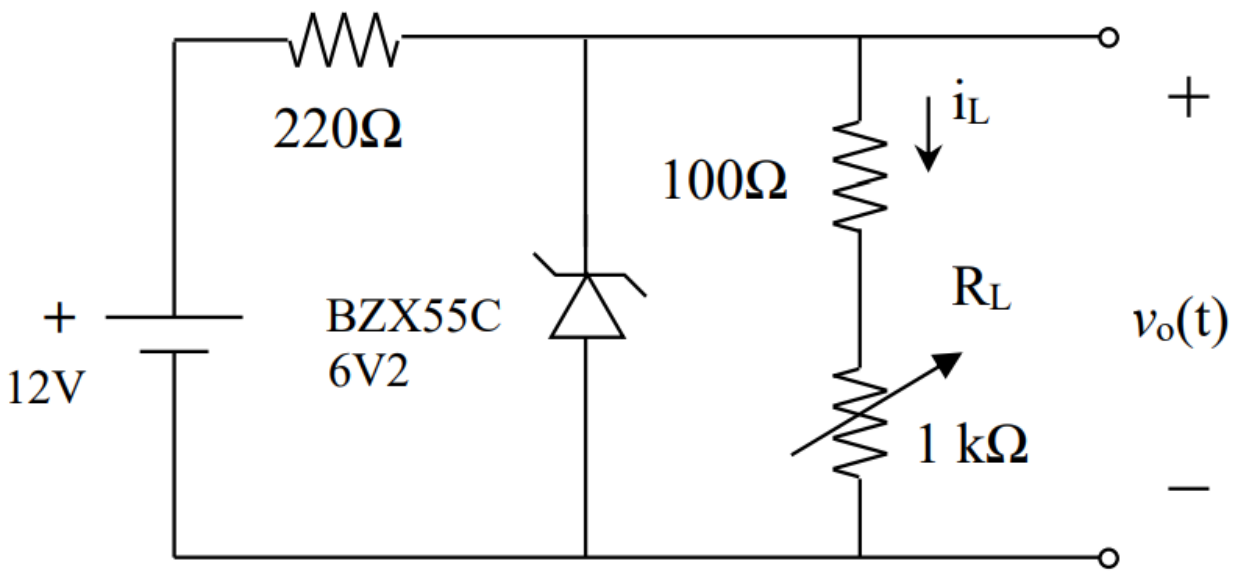

Figure 21: Regulation with zener diode circuit schematic for the Step 10

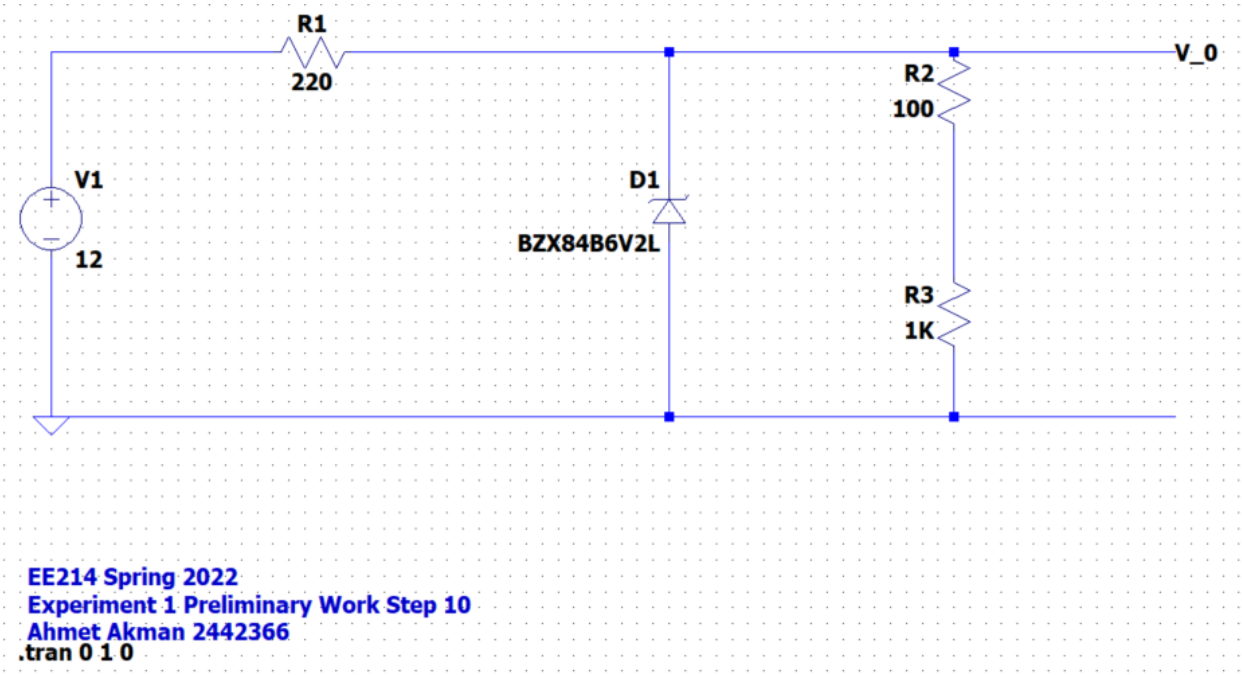

Figure 22: Regulation with zener diode circuit simulation schematic for the Step 10

12 Step 11

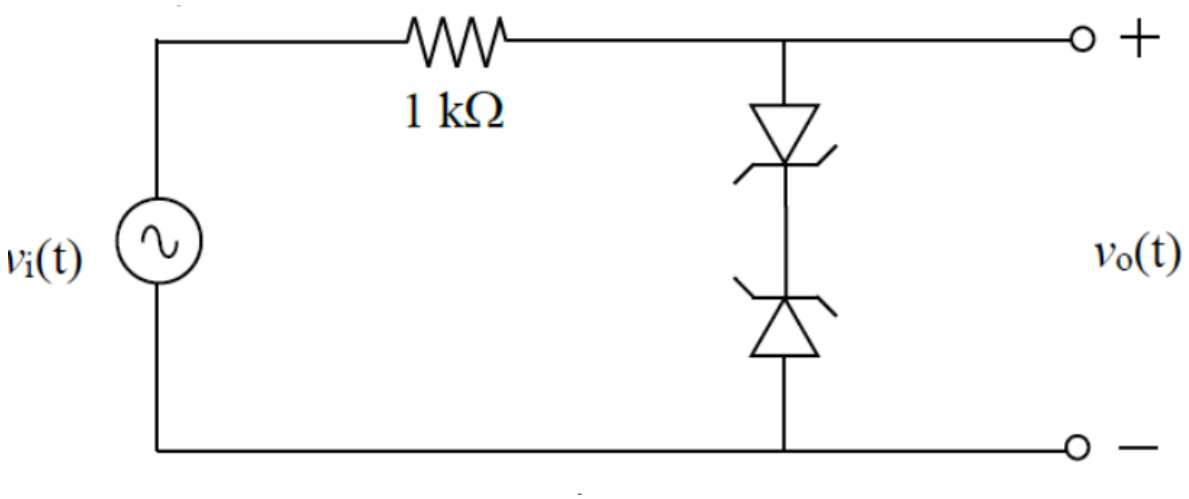

Figure 23: Clipper circuit schematic for the Step 11

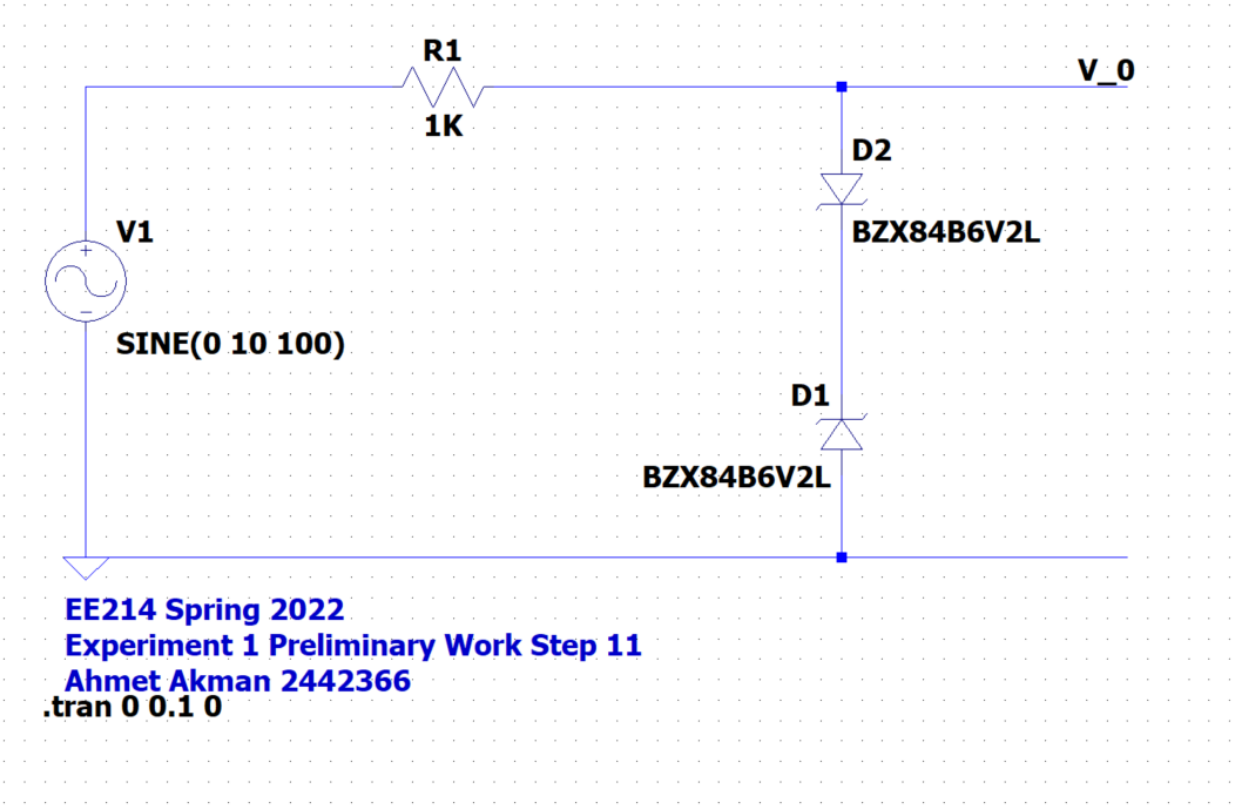

Figure 24: Clipper circuit simulation schematic for the Step 11

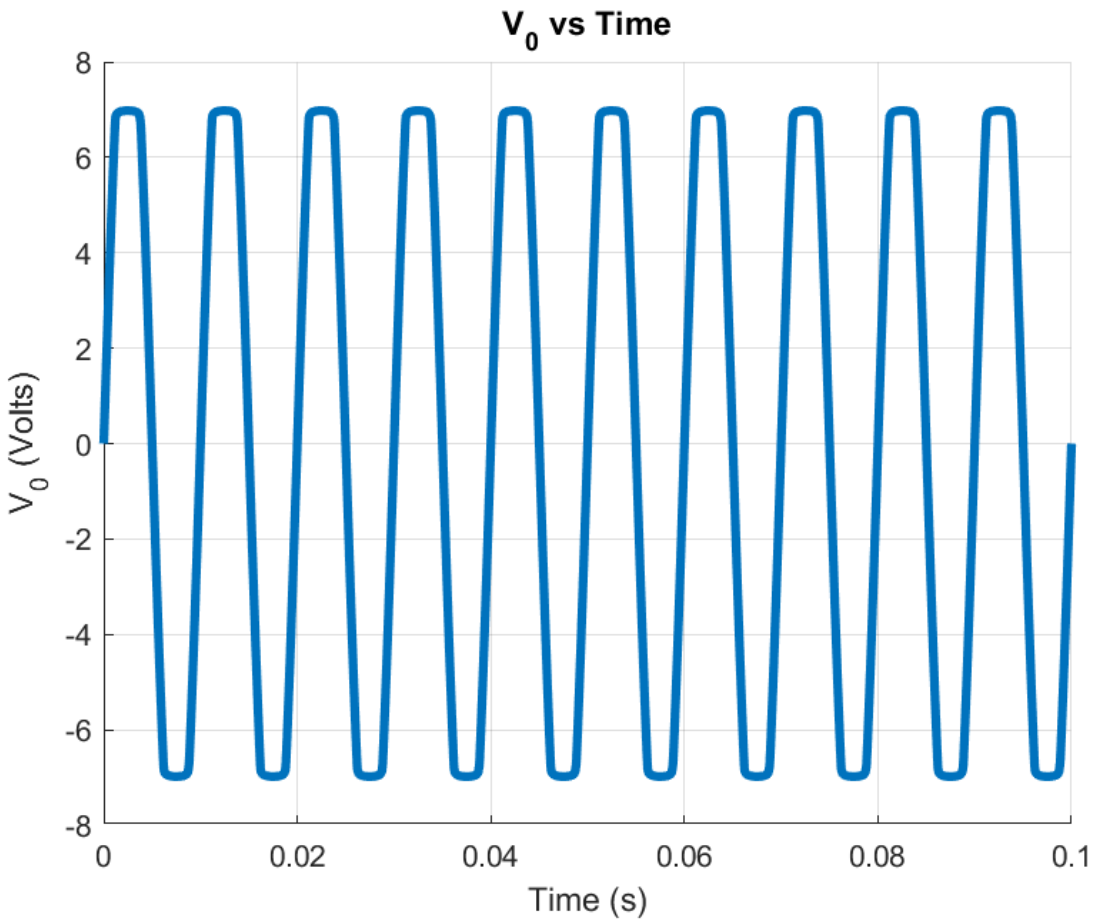

Figure 25: Clipper circuit simulation plot V_o

13 Conclusion